

FCC ID: VQ5-EBI10

## EMI -- TEST REPORT

Test Report No. :

**T32050-00-12HS**

11. December 2007

Date of issue

Type / Model Name : EBI 10

Product Description : Data logger (13.56 MHz, 2.4 GHz)

**Applicant** : Ebro Electronic GmbH & Co. KG

Address : Peringerstr. 10

DE-85055 Ingolstadt

**Manufacturer** : Ebro Electronic GmbH & Co. KG

Address : Peringerstr. 10

DE-85055 Ingolstadt

**Licence holder** : Ebro Electronic GmbH & Co. KG

Address : Peringerstr. 10

DE-85055 Ingolstadt

**Test Result** according to the  
standards listed in clause 1 test  
standards:

**Positive**



The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test  
results without the written permission of the test  
laboratory.

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## 1 TEST STANDARDS

The tests were performed according to following standards:

### FCC Rules and Regulations Part 15 Subpart C - Intentional Radiators (May 04, 2007)

|  |   |
|--|---|
| Part 1, Section 1.1310                   | Radio frequency exposure limits                                     |
| Part 2, Section 2.1093                   | RFE portable device   |
| Part 15, Subpart A, Section 15.31        | Measuring standards   |
| Part 15, Subpart A, Section 15.33        | Frequency range of radiated measurements                            |
| Part 15, Subpart C, Section 15.203       | Antenna requirement   |
| Part 15, Subpart C, Section 15.204       | External radio frequency power amplifiers and antenna modifications |
| Part 15, Subpart C, Section 15.205       | Restricted bands of operation                                       |
| Part 15, Subpart C, Section 15.212       | Modular transmitter   |
| Part 15, Subpart C, Section 15.207(a)    | AC Line conducted emissions   |
| Part 15, Subpart C, Section 15.209(a)    | Radiated emissions, general requirements                            |
| Part 15, Subpart C, Section 15.247(d)    | Radiated emissions, outside the used frequency band                 |
| Part 15, Subpart C, Section 15.247(a)(2) | Bandwidth requirement   |
| Part 15, Subpart C, Section 15.247(b)(3) | Maximum Peak conducted output Power                                 |
| Part 15, Subpart C, Section 15.247(i)    | Exposure of radio frequency energy levels                           |

### FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (May 04, 2007)

|                                       |  |
|---------------------------------------|--|
| Part 15, Subpart B, Section 15.107(a) | AC Line conducted emissions              |
| Part 15, Subpart B, Section 15.109(a) | Radiated emissions, general requirements |

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## **2 SUMMARY**

### **GENERAL REMARKS:**

The EUT works at 13.56 MHz and 2.400 GHz – 2.4835 GHz. The transmitter 13.56 MHz did pass the tests according FCC 15.109 by mikes-testingpartners gmbh. For the measurements results please refer to the testreport T32050-00-11HS.

The frequency range was scanned from 30 MHz to 25000 MHz. All emissions not reported in this test report are more than 10 dB below the specified limit.

### **FINAL ASSESSMENT:**

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 24. September 2007

Testing concluded on : 10. December 2007

Checked by:

Tested by:

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Klaus Gegenfurtner  
Dipl.-Ing.(FH)  
Manager: Radio Group

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Hermann Smetana  
Dipl.-Ing.(FH)  
Radio Expert

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### **3 EQUIPMENT UNDER TEST**

#### **3.1 Photo documentation of the EUT**

External views of the data logger family EBI 10:

Top view, Logger with internal temperature sensor



Top view, Logger with external temperature sensor



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Side view, Logger with external temperature sensor

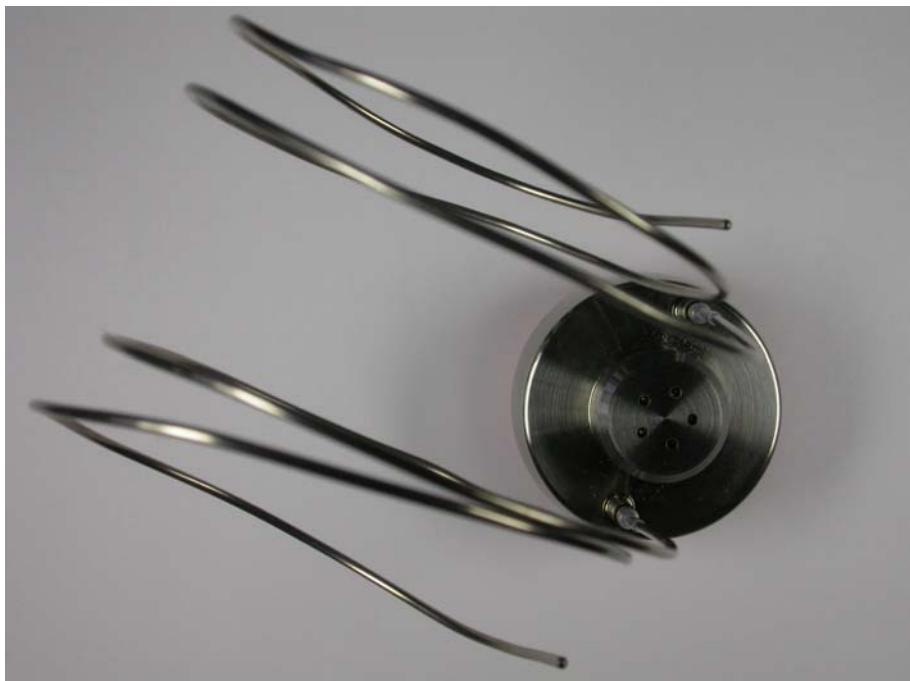


Top view, Logger with pressure sensor

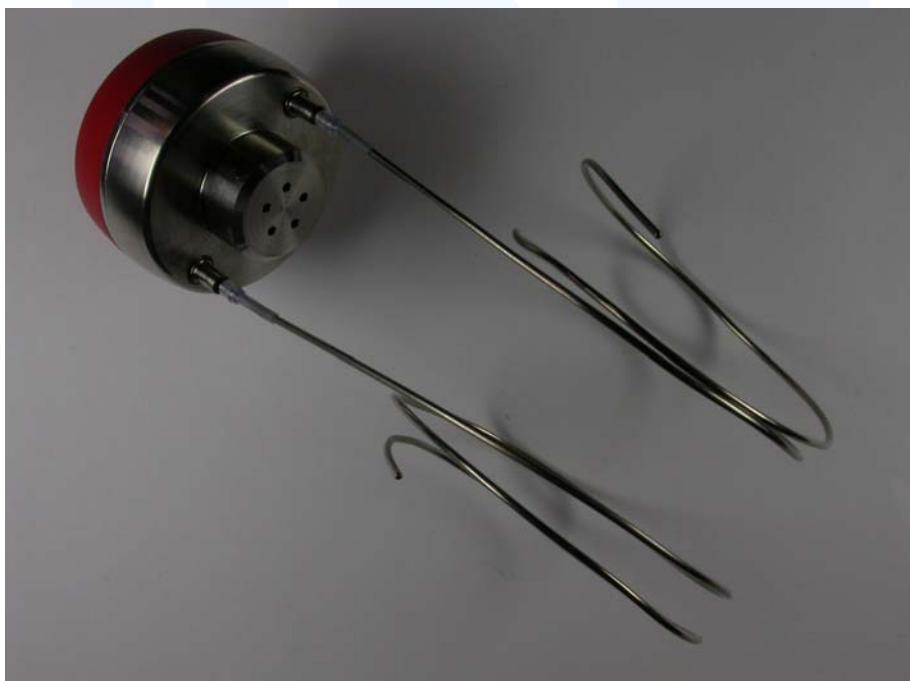


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Top view, Logger with pressure sensor and external temperature sensor

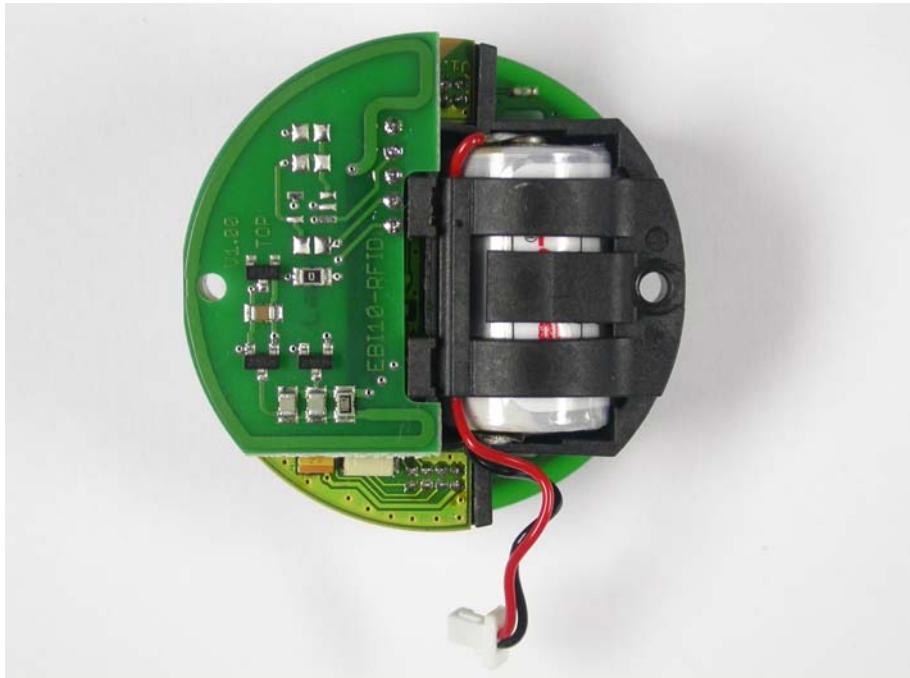


Side view, Logger with pressure sensor and external temperature sensor

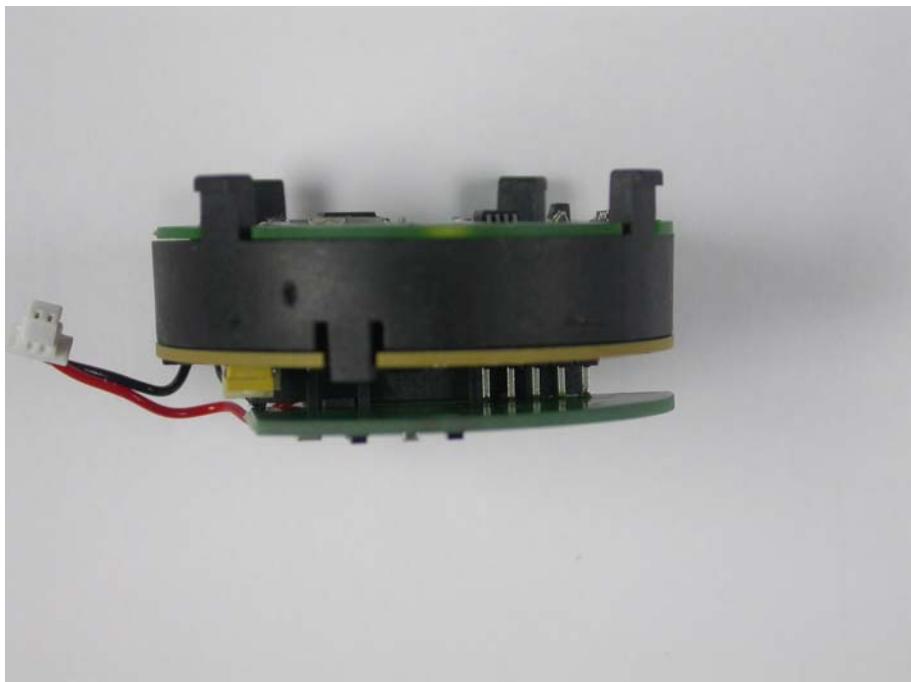


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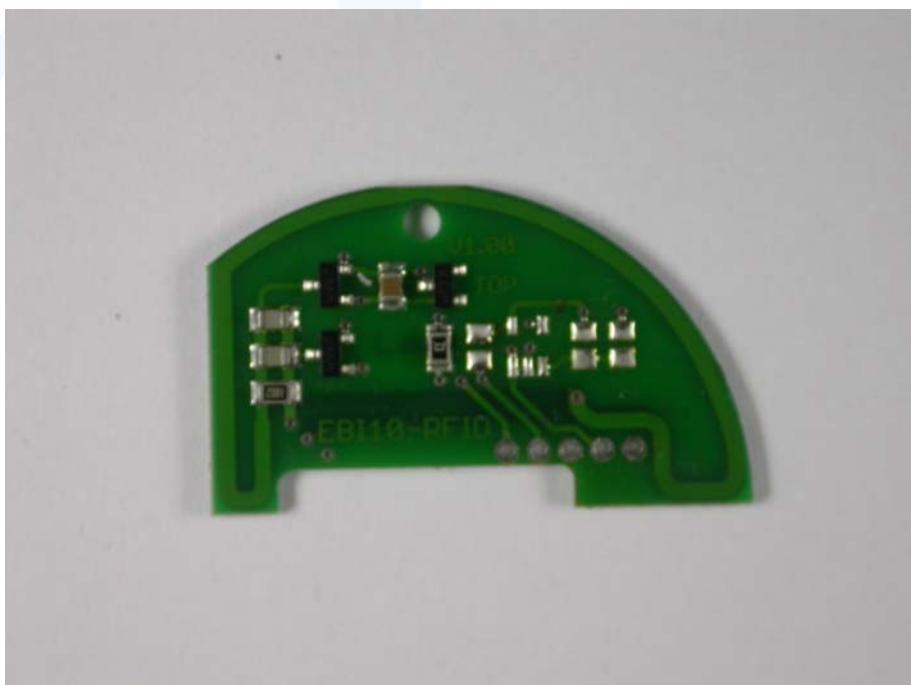
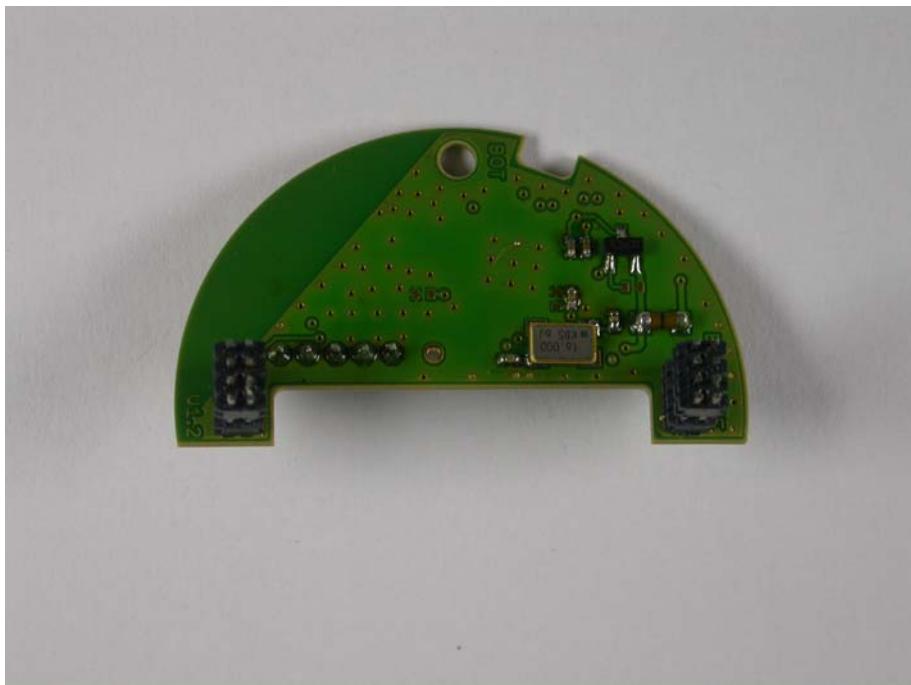
Internal views of the logger:



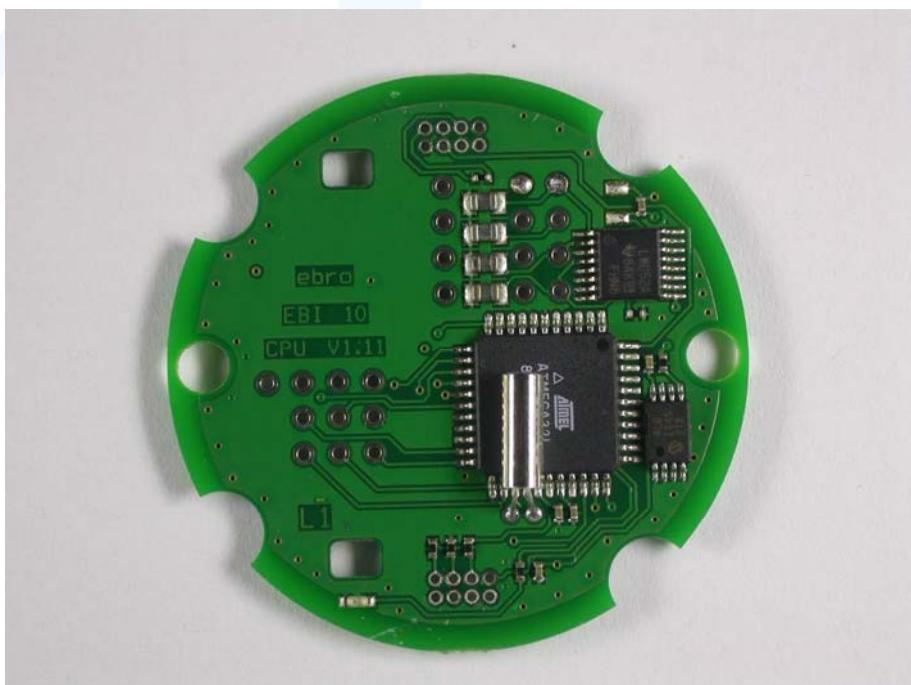
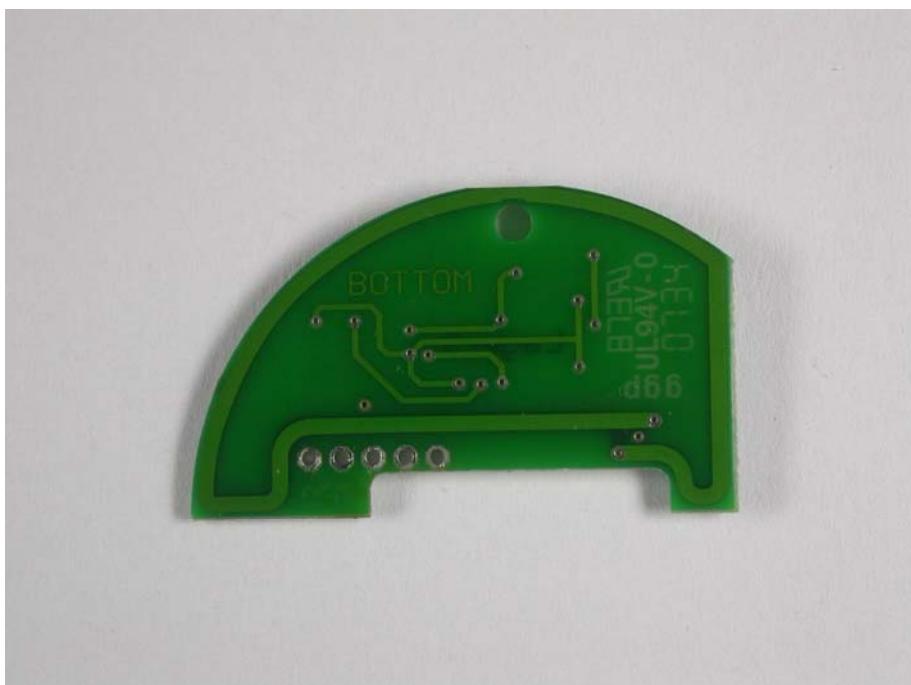
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### 3.2 Power supply system utilised

Power supply voltage : 3.6 V, Lithium Battery powered, (Size=1/2AA)

### 3.3 Short description of the Equipment under Test (EUT)

Data logger for temperature and pressure. Up to 4 mobile data logger can be used by one interface. The interface identifies a logger in the programming slot via 13.56 MHz RFID-Transceiver. In the mobile data logger is a RFID-Tag only. A 2.4 GHz "ZIGBEE" port (Chipset according IEEE 802.15.4) is used for data exchange, communication and programming the data logger, if the logger is enabled for communication via 13.56 MHz signal. This enable signal is necessary to activate the 2.4 GHz interface, otherwise no communication is possible.

Number of tested samples: 1  
Serial number: Prototype

#### EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX-Mode

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#### The following peripheral devices and interface cables were connected during the measurements:

- \_\_\_\_\_ Model : \_\_\_\_\_

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## **4 TEST ENVIRONMENT**

### **4.1 Address of the test laboratory**

**mikes-testingpartners gmbh**  
Ohmstrasse 2-4  
94342 Strasskirchen  
Germany

### **4.2 Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### **4.3 Statement of the measurement uncertainty**

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

## **4.4 Measurement Protocol for FCC, VCCI and AUSTEL**

### **4.4.1 GENERAL INFORMATION**

#### **4.4.1.1 Test Methodology**

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

In compliance with 47 CFR Part 15 Subpart A Section 15.38 testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

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#### 4.4.1.2 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

#### 4.4.2 DETAILS OF TEST PROCEDURES

##### 4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

#### 4.5 Discovery of worst case measurement conditions

For evaluating the worst case the data logger was driven in maximum output power mode and measured in X, Y and Z-Position. The data logger has no active RFID at 13.56 MHz. The logger was set into network mode to enable the communication for the 2.4 GHz interface. The maximum output power was found in X-Position. So the measurements were performed in this direction to express the worst case.

## **5 TEST CONDITIONS AND RESULTS**

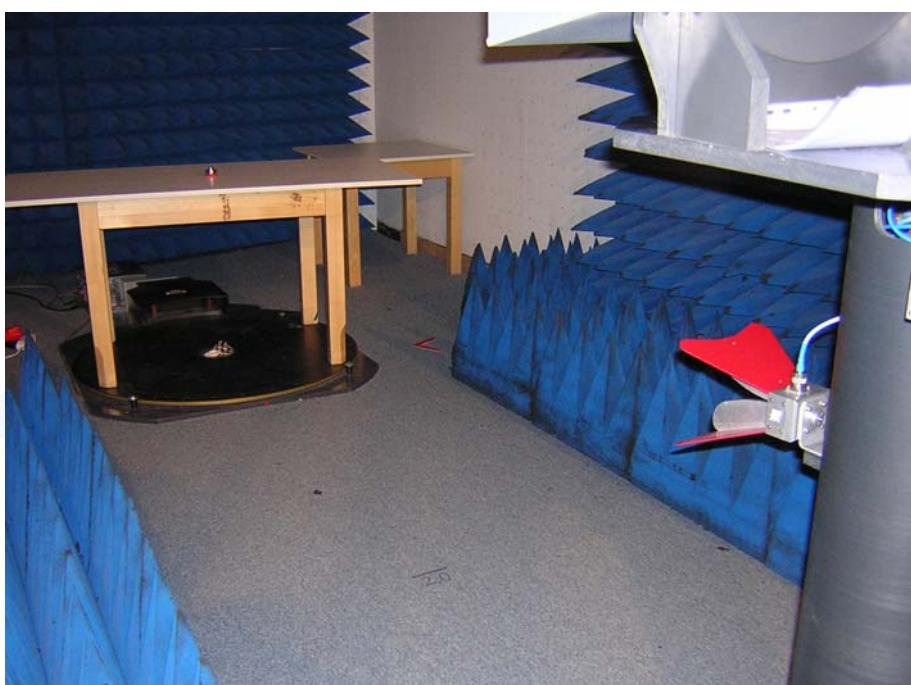
### **5.1 Maximum Peak Output Power**

For test instruments and accessories used see section 6 Part **SER 3**.

#### **5.1.1 Description of the test location**

Test location: AREA4

#### **5.1.2 Photo documentation of the test set-up**



#### **5.1.3 Description of Measurement**

##### **Maximum conducted peak output power:**

A spectrum analyzer / EMI test receiver is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode using the assigned frequency.

##### **Analyzer Settings:**

- Detector: Max hold
- RBW: greater than 20 dB Bandwidth
- VBW:  $\geq$  RBW
- Sweep Time: Coupled

##### **Alternative test procedure:**

If antenna conducted tests cannot be performed on the EUT, radiated tests to show compliance with the various conducted requirements of Section 15.247 are performed. A pre-amp have been used in making the following requirements.

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Radiated maximum peak output power:

Radiated maximum peak output power from the EUT is measured above 1 GHz, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 1 MHz. All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EUT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

Analyzer Settings:

- Detector: Max hold
- RBW: greater than 20 dB Bandwidth
- VBW:  $\geq$  RBW
- Sweep Time: Coupled

**5.1.4 Test result**

| Channel | Frequency<br>[GHz] | Peak power<br>[dBm] | Correct.<br>[dB] | Corr. peak power<br>[dBm] | Peak power limit<br>[dBm] | Delta<br>[dB] |
|---------|--------------------|---------------------|------------------|---------------------------|---------------------------|---------------|
| 11      | 2.4050             | -7.15               | -9.7             | -16.85                    | 30                        | -46.85        |
| 18      | 2.4400             | -17.87              | -9.7             | -27.57                    | 30                        | -57.57        |
| 26      | 2.4825             | -16.67              | -9.8             | -26.47                    | 30                        | -56.47        |

Peak Power Limit according to FCC Subpart 15.247(b)(3):

| Frequency<br>[MHz] | Peak power limit |            |
|--------------------|------------------|------------|
|                    | [dBm]            | [Watt]     |
| 902-928            | 30               | 1,0        |
| <b>2400-2483.5</b> | <b>30</b>        | <b>1,0</b> |
| 5725-5850          | 30               | 1,0        |

The requirements are **FULFILLED**.

**Remarks:** This test has been performed radiated because of dedicated antenna.

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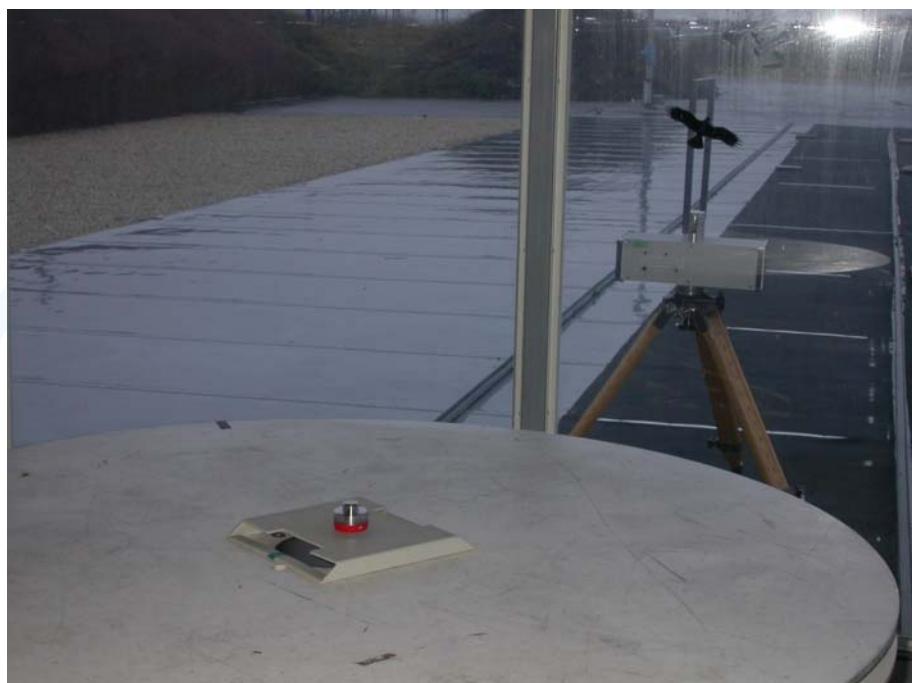
## 5.2 Radiated emissions 9 kHz – 40 GHz

For test instruments and accessories used see section 6 Part **SER1, SER 2 and SER 3**.

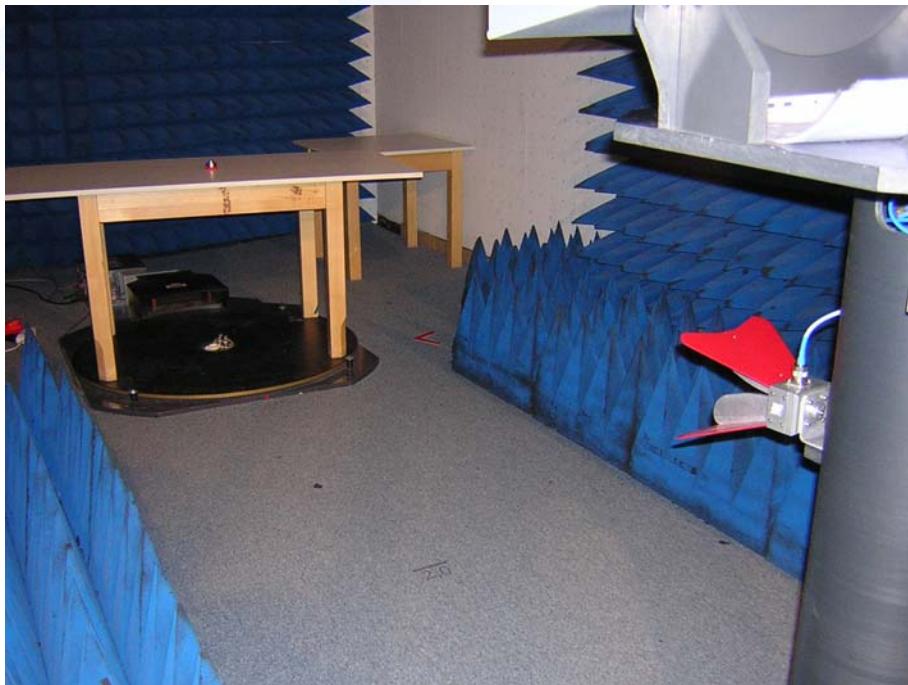
### 5.2.1 Description of the test location

Test location: OATS1  
Test location: Anechoic Chamber2  
Test distance: 3 metres  
Test distance: 3 metres

### 5.2.2 Photo documentation of the test set-up



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### 5.2.3 Description of Measurement

The spurious emissions from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except

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for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209 (d) [2].

mikes

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The final level, expressed in  $\text{dB}\mu\text{V}/\text{m}$ , is arrived at by taking the reading from the EMI receiver (Level  $\text{dB}\mu\text{V}$ ) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

Radiated spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EUT are rotated 360 degrees.

The final level, expressed in  $\text{dB}\mu\text{V}/\text{m}$ , is arrived by taking the reading from the EMI receiver (Level  $\text{dB}\mu\text{V}$ ) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The radiated emissions from the EUT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3m horizontally from the EUT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz and for any spurious emission or modulation product that falls in Restricted Band, as defined in Section 15.205, set the resolution and video bandwidth to 1 MHz.

All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EUT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

Analyzer Settings (EMI receiver) for spurious emissions which fall not in Restricted Band:

- Detector: Max hold
- RBW: 100 kHz for  $f \geq 1\text{GHz}$ , 120 kHz for  $f \leq 1\text{GHz}$
- VBW:  $\geq$  RBW
- Sweep Time: Coupled
- Detector function: Peak

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Analyzer Settings (EMI receiver) for spurious emissions which fall in Restricted Band:

- Detector: Max hold
- RBW: 1 MHz for  $f \geq 1\text{GHz}$ , 120 kHz for  $f \leq 1\text{GHz}$
- VBW:  $\geq$  RBW
- Sweep Time: Coupled
- Detector function: Peak for  $f \geq 1\text{GHz}$ , Quasi Peak for  $f \leq 1\text{GHz}$

#### 5.2.4 Test result

##### Testresult in detail: (<1GHz)

Corrected field strength of fundamental wave as reference for radiated emissions:

99.8 dB $\mu$ V/m

| Frequency [MHz] | Restricted Band | Channel 11                    |                               |                               |                 |                      |                                   |                                   |                                   |                      |      | Delta [dB] |
|-----------------|-----------------|-------------------------------|-------------------------------|-------------------------------|-----------------|----------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------|------|------------|
|                 |                 | Reading Level QP [dB $\mu$ V] | Reading Level AV [dB $\mu$ V] | Reading Level PK [dB $\mu$ V] | Bandwidth [kHz] | Correct. factor [dB] | Corrected Level QP [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Corrected Level PK [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | PK   | QP         |
| 0.009-0.15      |                 |                               |                               |                               | 0.2             |                      | < 30                              |                                   |                                   |                      |      |            |
| 0.15-30         |                 |                               |                               |                               | 9               |                      | < 30                              |                                   |                                   |                      |      |            |
| 30-1000         |                 |                               |                               |                               |                 |                      |                                   |                                   |                                   |                      |      |            |
| 30-88           | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 40   | > -10,0    |
| 88-216          | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 43,5 | > -13,5    |
| 216-960         | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 46   | > -16,0    |
| 960-1000        | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 54   | > -24,0    |

Corrected field strength of fundamental wave as reference for radiated emissions:

89.13 dB $\mu$ V/m

| Frequency [MHz] | Restricted Band | Channel 18                    |                               |                               |                 |                      |                                   |                                   |                                   |                      |      | Delta [dB] |
|-----------------|-----------------|-------------------------------|-------------------------------|-------------------------------|-----------------|----------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------|------|------------|
|                 |                 | Reading Level QP [dB $\mu$ V] | Reading Level AV [dB $\mu$ V] | Reading Level PK [dB $\mu$ V] | Bandwidth [kHz] | Correct. factor [dB] | Corrected Level QP [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Corrected Level PK [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | PK   | QP         |
| 0.009-0.15      |                 |                               |                               |                               | 0.2             |                      | < 30                              |                                   |                                   |                      |      |            |
| 0.15-30         |                 |                               |                               |                               | 9               |                      | < 30                              |                                   |                                   |                      |      |            |
| 30-1000         |                 |                               |                               |                               |                 |                      |                                   |                                   |                                   |                      |      |            |
| 30-88           | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 40   | > -10,0    |
| 88-216          | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 43,5 | > -13,5    |
| 216-960         | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 46   | > -16,0    |
| 960-1000        | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 54   | > -24,0    |

Corrected field strength of fundamental wave as reference for radiated emissions:

98.3 dB $\mu$ V/m

| Frequency [MHz] | Restricted Band | Channel 26                    |                               |                               |                 |                      |                                   |                                   |                                   |                      |      | Delta [dB] |
|-----------------|-----------------|-------------------------------|-------------------------------|-------------------------------|-----------------|----------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------|------|------------|
|                 |                 | Reading Level QP [dB $\mu$ V] | Reading Level AV [dB $\mu$ V] | Reading Level PK [dB $\mu$ V] | Bandwidth [kHz] | Correct. factor [dB] | Corrected Level QP [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Corrected Level PK [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | PK   | QP         |
| 0.009-0.15      |                 |                               |                               |                               | 0.2             |                      | < 30                              |                                   |                                   |                      |      |            |
| 0.15-30         |                 |                               |                               |                               | 9               |                      | < 30                              |                                   |                                   |                      |      |            |
| 30-1000         |                 |                               |                               |                               |                 |                      |                                   |                                   |                                   |                      |      |            |
| 30-88           | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 40   | > -10,0    |
| 88-216          | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 43,5 | > -13,5    |
| 216-960         | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 46   | > -16,0    |
| 960-1000        | ■               |                               |                               |                               | 120             |                      | < 30                              |                                   |                                   |                      | 54   | > -24,0    |

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Testresult in detail:(>1GHz)

Corrected field strength of fundamental wave as reference for radiated emissions:

90.1 dB $\mu$ V/m

| Channel 11      |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |
|-----------------|-----------------|-------------------------------|-----------------------|--------------------------|------------------|----------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|------------|
| Frequency [MHz] | Restricted Band | Reading Level PK [dB $\mu$ V] | Corr. Duty Cycle [dB] | Level AV [dB $\mu$ V *]) | Band-width [kHz] | Correct. Factor [dB] | Corrected Level PK [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Limit PK [dB $\mu$ V/m] | Limit AV [dB $\mu$ V/m] | Delta [dB] |
| 1000-25000      |                 |                               |                       |                          | 1000             |                      |                                   | < 45                              |                         | 54                      | > -9       |
|                 |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |

Corrected field strength of fundamental wave as reference for radiated emissions:

79.4 dB $\mu$ V/m

| Channel 18      |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |
|-----------------|-----------------|-------------------------------|-----------------------|--------------------------|------------------|----------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|------------|
| Frequency [MHz] | Restricted Band | Reading Level PK [dB $\mu$ V] | Corr. Duty Cycle [dB] | Level AV [dB $\mu$ V *]) | Band-width [kHz] | Correct. Factor [dB] | Corrected Level PK [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Limit PK [dB $\mu$ V/m] | Limit AV [dB $\mu$ V/m] | Delta [dB] |
| 1000-25000      |                 |                               |                       |                          | 1000             |                      |                                   | < 45                              |                         | 54                      | > -9       |
|                 |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |

Corrected field strength of fundamental wave as reference for radiated emissions:

80.5 dB $\mu$ V/m

| Channel 26      |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |
|-----------------|-----------------|-------------------------------|-----------------------|--------------------------|------------------|----------------------|-----------------------------------|-----------------------------------|-------------------------|-------------------------|------------|
| Frequency [MHz] | Restricted Band | Reading Level PK [dB $\mu$ V] | Corr. Duty Cycle [dB] | Level AV [dB $\mu$ V *]) | Band-width [kHz] | Correct. Factor [dB] | Corrected Level PK [dB $\mu$ V/m] | Corrected Level AV [dB $\mu$ V/m] | Limit PK [dB $\mu$ V/m] | Limit AV [dB $\mu$ V/m] | Delta [dB] |
| 1000-25000      |                 |                               |                       |                          | 1000             |                      |                                   | < 45                              |                         | 54                      | > -9       |
|                 |                 |                               |                       |                          |                  |                      |                                   |                                   |                         |                         |            |

\*) Average values were measured with spectrum analyzer by taking the following Settings

RBW: 1 MHz

VBW: 10 Hz

Sweep: Auto

Peak-Limit according to FCC Subpart 15.247(d):

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

Final radiated limits for spurious emissions which fall not in restricted bands:

| Frequency [MHz] | Limits acc. 15.209 [dB $\mu$ V/m] | Measurement distance [metres] | Limits acc. 15.247(c) [dB $\mu$ V/m] |       |       | Final Radiated Limits [dB $\mu$ V/m] |       |       |
|-----------------|-----------------------------------|-------------------------------|--------------------------------------|-------|-------|--------------------------------------|-------|-------|
|                 |                                   |                               | Ch 11                                | Ch 18 | Ch 26 | Ch 11                                | Ch 18 | Ch 26 |
| 0,009-0,490     | 2400/F(kHz)                       | 300                           | 76.6                                 | 78.5  | 78.3  | -3.4                                 | -1.5  | -1.7  |
| 0,490-1,705     | 24000/F(kHz)                      | 30                            | 76.6                                 | 78.5  | 78.3  | 36.6                                 | 38.5  | 38.3  |
| 1,705-30        | 30                                | 30                            | 76.6                                 | 78.5  | 78.3  | 36.6                                 | 38.5  | 38.3  |

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|           |      |   |      |      |      |      |      |      |
|-----------|------|---|------|------|------|------|------|------|
| 30-88     | 40   | 3 | 76.6 | 78.5 | 78.3 | 76.6 | 78.5 | 78.3 |
| 88-216    | 43,5 | 3 | 76.6 | 78.5 | 78.3 | 76.6 | 78.5 | 78.3 |
| 216-960   | 46   | 3 | 76.6 | 78.5 | 78.3 | 76.6 | 78.5 | 78.3 |
| Above 960 | 54   | 3 | 76.6 | 78.5 | 78.3 | 76.6 | 78.5 | 78.3 |

Radiated limits according to FCC Part 15 Subpart 15.209(a) for spurious emissions which fall in restricted bands:

| Frequency<br>[MHz] | Field strength of spurious<br>emissions |                 | Measurement distance<br>[metres] |
|--------------------|---|-----------------|----------------------------------|
|                    | [ $\mu$ V/m]                            | dB [ $\mu$ V/m] |                                  |
| 0,009-0,490        | 2400/F(kHz)                             |                 | 300                              |
| 0,490-1,705        | 24000/F(kHz)                            |                 | 30                               |
| 1,705-30           | 30                                      | 29,5            | 30                               |
| 30-88              | 100                                     | 40              | 3                                |
| 88-216             | 150                                     | 43,5            | 3                                |
| 216-960            | 200                                     | 46              | 3                                |
| Above 960          | 500                                     | 54              | 3                                |

#### Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 – 0.110       | 16.42 – 16.423        | 399.9 – 410     | 4.5 – 5.15    |
| 0.495 – 0.505       | 16.69475 – 16.69525   | 608 – 614       | 5.35 – 5.46   |
| 2.1735 – 2.1905     | 16.80425 – 16.80475   | 960 – 1240      | 7.25 – 7.75   |
| 4.125 – 4.128       | 25.5 – 25.67          | 1300 – 1427     | 8.025 – 8.5   |
| 4.17725 – 4.17775   | 37.5 – 38.25          | 1435 – 1626.5   | 9.0 – 9.2     |
| 4.20725 – 4.20775   | 73 – 74.6             | 1645.5 – 1646.5 | 9.3 – 9.5     |
| 6.215 – 6.218       | 74.8 – 75.2           | 1660 – 1710     | 10.6 – 12.7   |
| 6.26775 – 6.26825   | 108 – 121.94          | 1718.8 – 1722.2 | 13.25 – 13.4  |
| 6.31175 – 6.31225   | 123 – 138             | 2200 – 2300     | 14.47 – 14.5  |
| 8.291 – 8.294       | 149.9 – 150.05        | 2310 – 2390     | 15.35 – 16.2  |
| 8.362 – 8.366       | 156.52475 – 156.52525 | 2483.5 – 2500   | 17.7 – 21.4   |
| 8.37625 – 8.38675   | 156.7 – 156.9         | 2690 – 2900     | 22.01 – 23.12 |
| 8.41425 – 8.41475   | 162.0125 – 167.17     | 3260 – 3267     | 23.6 – 24.0   |
| 12.29 – 12.293      | 167.72 – 173.2        | 3332 – 3339     | 31.2 – 31.8   |
| 12.51975 – 12.52025 | 240 – 285             | 3345.8 – 3358   | 36.43 – 36.5  |
| 12.57675 – 12.57725 | 322 – 335.4           | 3600 – 4400     |               |

The requirements are **FULFILLED**.

**Remarks:** During the test, the EUT was set into normal modulation mode as intended for use.

The measurement was performed up to the 10<sup>th</sup> harmonic (25000MHz).

FCC ID: VQ5-EBI10

### 5.3 6 dB Bandwidth

For test instruments and accessories used see section 6 Part **MB**.

#### 5.3.1 Description of the test location

Test location: AREA4

#### 5.3.2 Photo documentation of the test set-up



#### 5.3.3 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -6 dB. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The resolution bandwidth of measuring instrument was set to a value as shown in the following table below according to ANSI C63.4-2003.

| Fundamental frequency | Minimum resolution bandwidth |
|-----------------------|------------------------------|
| 9 kHz to 30 MHz       | 1kHz                         |
| 30 to 1000 MHz        | 10 kHz                       |
| 1000 MHz to 40 GHz    | 100 kHz                      |

FCC ID: VQ5-EBI10

## 5.3.4 Test result

| Channel number | Fundamental frequency [MHz] | 6 dB Bandwidth [MHz] | Minimum limit [MHz] |
|----------------|-----------------------------|----------------------|---------------------|
| 11             | 2405                        | 2.520                | 0,5                 |
| 18             | 2440                        | 2.500                | 0,5                 |
| 26             | 2480                        | 2.540                | 0,5                 |

Limit according to FCC Subpart 15.247 (a)(2):

The minimum 6 dB bandwidth shall be at least 500 kHz

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please refer to following test protocol.

\_\_\_\_\_

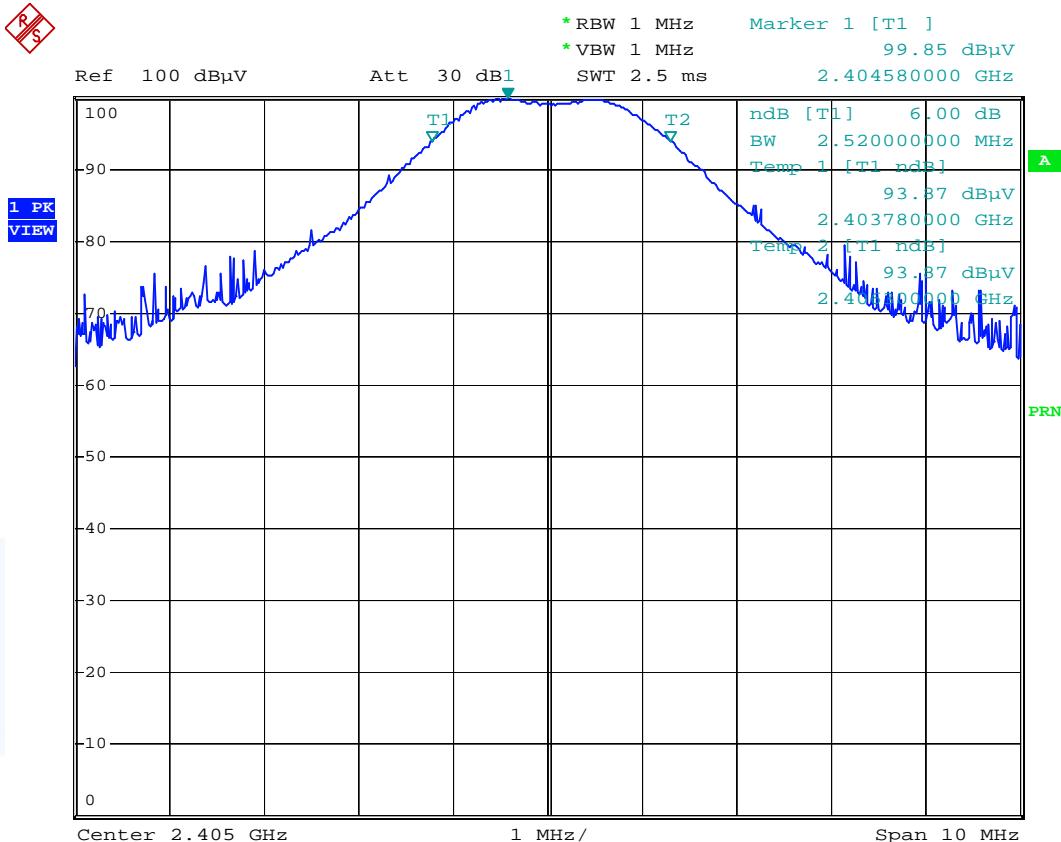
\_\_\_\_\_

FCC ID: VQ5-EBI10

### 5.3.5 Test protocol

#### 6dB Bandwidth Measurement FCC Part 15 Subpart 15.247(a)(2)

##### Channel 11

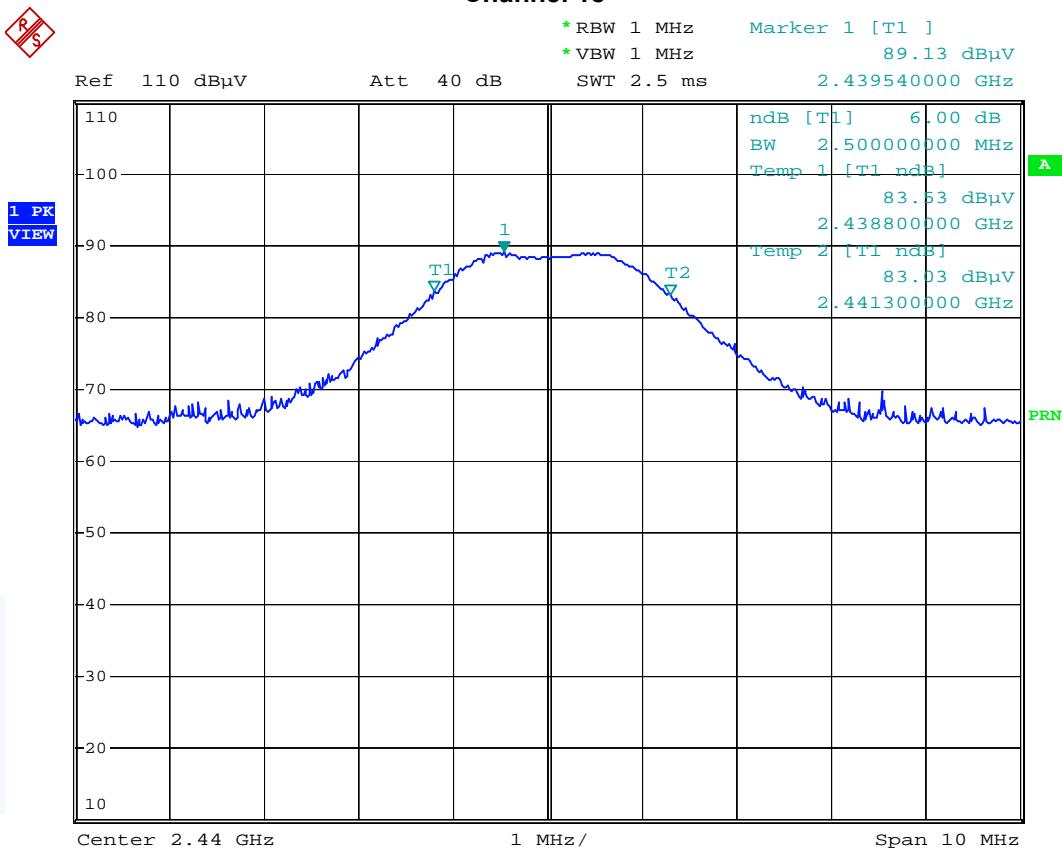


Comment: EBRO, Logger EBI 10, PCB-Ant., TX-Mode  
Comment: PosY, File64, vertikal  
Date: 16.OCT.2007 10:13:48

FCC ID: VQ5-EBI10

**6dB Bandwidth Measurement**  
FCC Part 15 Subpart 15.247(a)(2)

**Channel 18**



Comment: EBRO, Logger EBI 10, PCB-Ant., TX-Mode, Kanal18

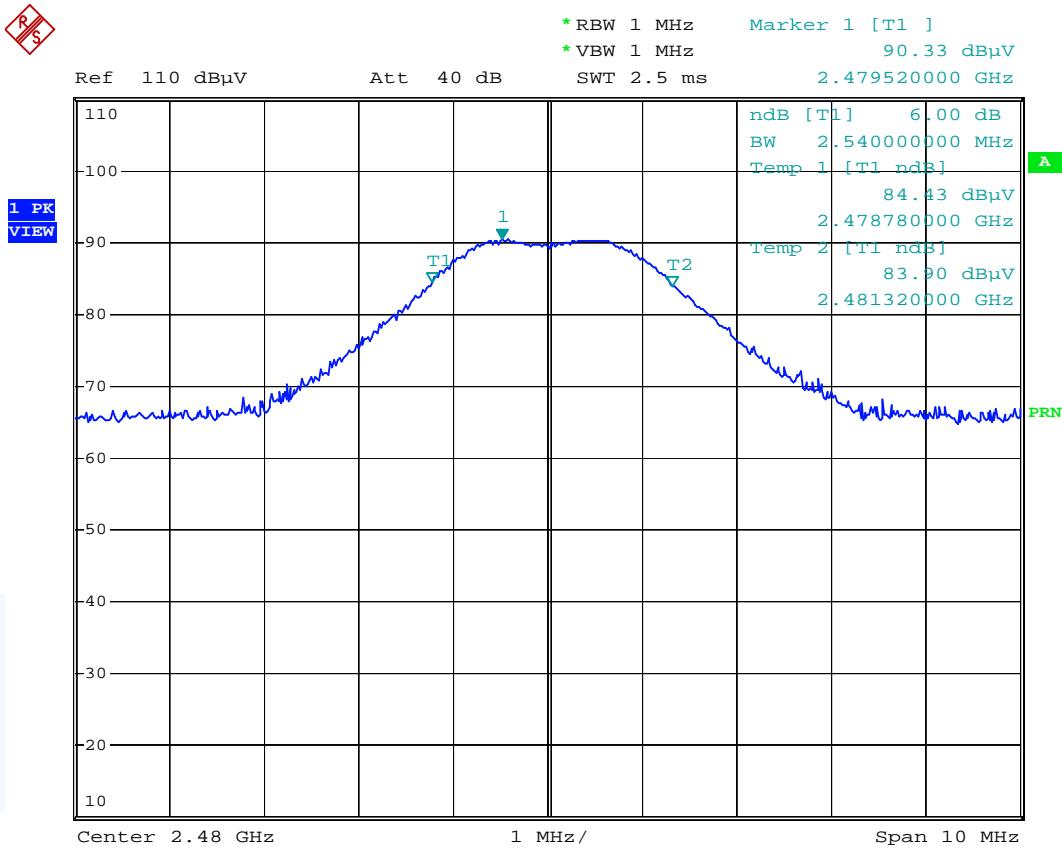
Comment: PosY, File67, horiz.

Date: 16.OCT.2007 10:43:49

FCC ID: VQ5-EBI10

**6dB Bandwidth Measurement**  
FCC Part 15 Subpart 15.247(a)(2)

**Channel 26**



Comment: EBRO, Logger EBI 10, PCB-Ant., TX-Mode, Kanal18

Comment: PosY, File69, vert.

Date: 16.OCT.2007 10:52:05

FCC ID: VQ5-EBI10

## 5.4 Band edge test

For test instruments and accessories used see section 6 Part **MB**.

### 5.4.1 Description of the test location

Test location: AREA4

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 Description of Measurement

The EUT was connected to the spectrum analyzer with a suitable attenuator. The span of the spectrum analyzer was set wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation. The highest amplitude appearing on spectral display was measured and it was set as the reference level for the emission mask.

It was allowed the trace to stabilize and after then it was set the emission mask on the reference level to show the compliance with the bandedge requirements.

Further settings on the spectrum analyzer:

RBW:  $\geq 1\%$  of the span

VBW:  $\geq$  RBW

Sweep: Auto

Detector function: Peak

**FCC ID: VQ5-EBI10**
**5.4.4 Test result**

| Frequency<br>[GHz] | Peak Power Output<br>[dB $\mu$ V] | Spurious emission<br>read value<br>[dB $\mu$ V] | Result of<br>Band edge<br>[dBc] | Band edge<br>LIMIT<br>[dBc] |
|--------------------|-----------------------------------|---|---------------------------------|-----------------------------|
| < 2.400            | 90.1                              | 45  | 45.1                            | ≥ 20                        |
| > 2.4835           | 80.5                              | 50  | 30.5                            | ≥ 20                        |

Peak-Limit according to FCC Subpart 15.247(d):

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

Additional requirement according to 15.205(a) restricted band (2.4835 GHz – 2.5000 GHz):

| Frequency<br>[MHz] | Reading<br>Level PK<br>[dB $\mu$ V] | Correct.<br>Duty<br>Cycle<br>[dB] | Level<br>AV<br>[dB $\mu$ V] | Band-<br>Width<br>[kHz] | Correct.<br>Factor<br>[dB] | Correct.<br>Level PK<br>[dB $\mu$ V/m] | Correct.<br>Level AV<br>[dB $\mu$ V/m] | Limit PK<br>[dB $\mu$ V/m] | Limit AV<br>[dB $\mu$ V/m] | Delta<br>[dB] |
|--------------------|-------------------------------------|-----------------------------------|-----------------------------|-------------------------|----------------------------|--|--|----------------------------|----------------------------|---------------|
| 2483.5             | 50.0                                | -                                 |                             | 30                      | -10.2                      | 39.8                                   |  | 74.0                       | 54.0                       | -34.8         |

The requirements are **FULFILLED**.

**Remarks:** For detailed test results please refer to following test protocol.

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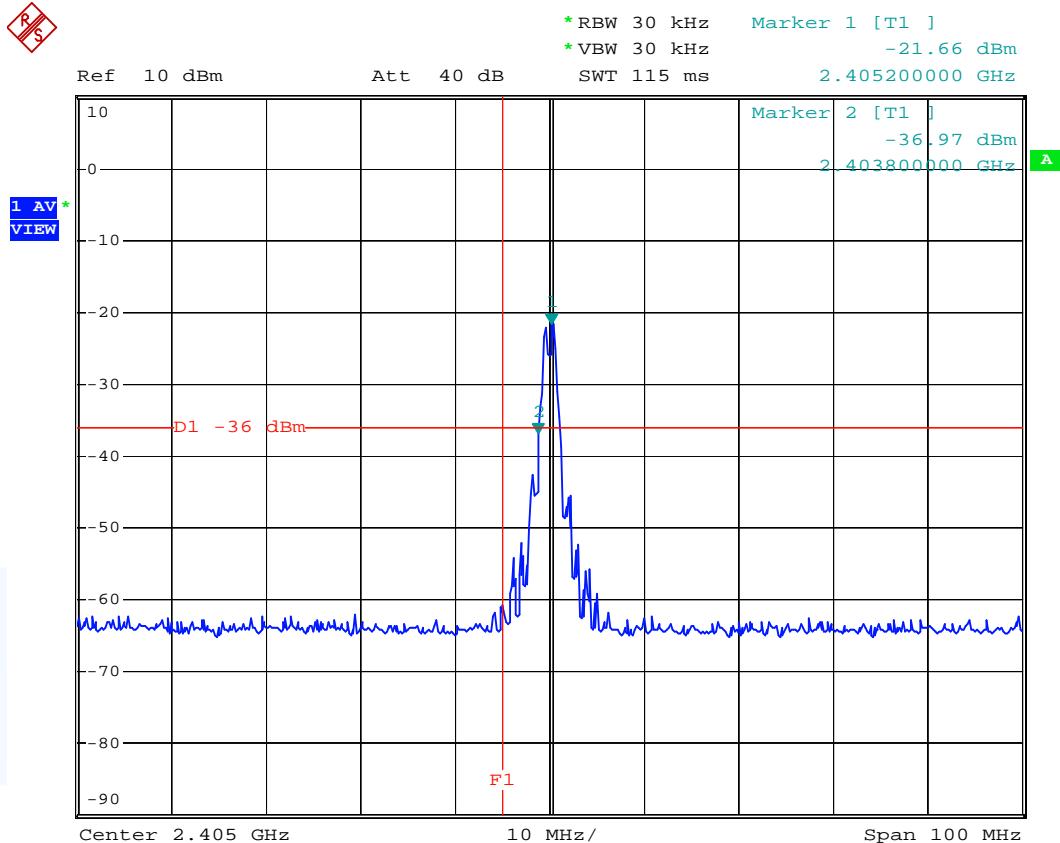


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FCC ID: VQ5-EBI10

**5.4.5 Test protocol**

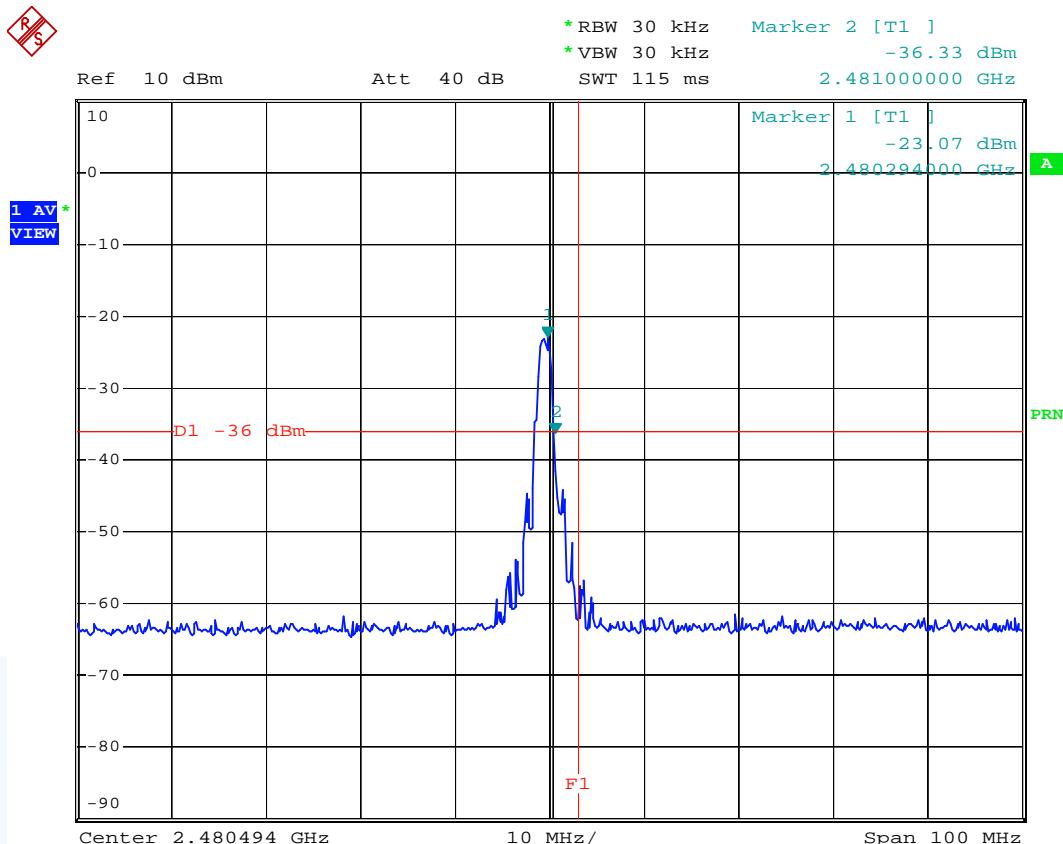
**Lower Channel  
2405 MHz**



Comment: ixp, EBRO,  
Comment: FR, File 58, 55C, +15V, K11  
Date: 10.OCT.2007 15:45:40

FCC ID: VQ5-EBI10

**Higher Channel  
2480 MHz**



Comment: ixp, EBRO,  
 Comment: FR, File 55, 55C, +15V, K26  
 Date: 10.OCT.2007 15:07:53

FCC ID: VQ5-EBI10

## 5.5 Peak Power Density

For test instruments and accessories used see section 6 Part **SER 3**.

### 5.5.1 Description of the test location

Test location: AREA4

### 5.5.2 Photo documentation of the test set-up



### 5.5.3 Description of Measurement

The EUT was connected to the spectrum analyzer with a suitable attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW= 3 kHz and VBW= 3 kHz, set sweep time equal to Span/3 kHz. The power spectral density was measured and recorded.

Settings on the spectrum analyzer:

RBW: 3 kHz  
 VBW: 30 kHz  
 Sweep: auto  
 Detecter function: Peak

### 5.5.4 Test result

| Channel | Fundamental frequency<br>[MHz] | Peak Power density<br>[dBm/MHz] |
|---------|--------------------------------|---------------------------------|
| 11      | 2.405                          | -27.88                          |
| 18      | 2.440                          | -24.19                          |
| 26      | 2.480                          | -24.57                          |

**FCC ID: VQ5-EBI10**

Limit according to FCC Subpart 15.247 (e):

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band.

The requirements are **FULFILLED**.

**Remarks:**

\_\_\_\_\_  
\_\_\_\_\_

mikes

FCC ID: VQ5-EBI10

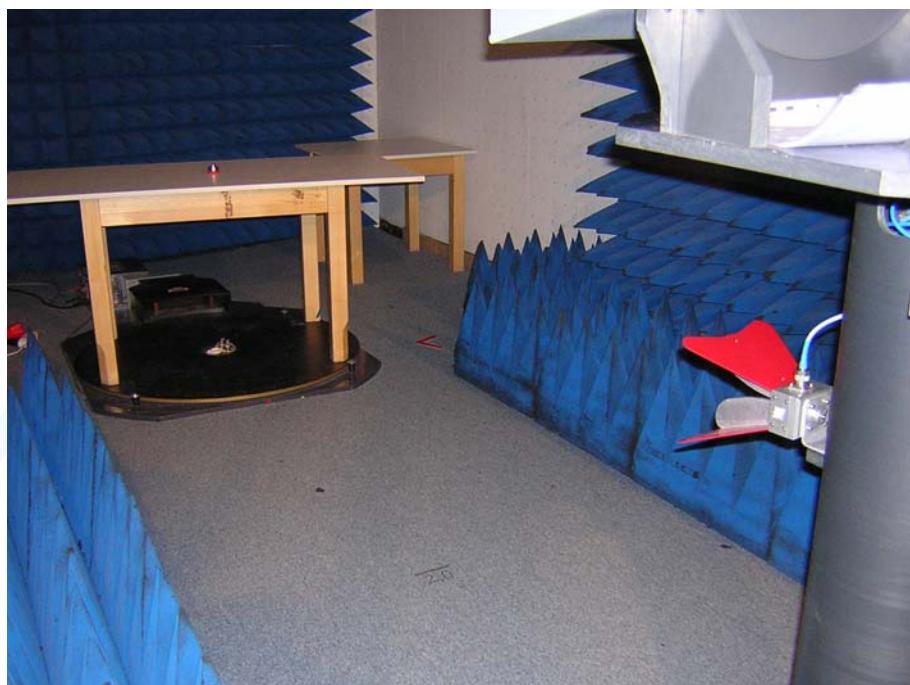
## 5.6 Maximum Permissible Exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC3**.

### 5.6.1 Description of the test location

Test location: AREA4

### 5.6.2 Photo documentation of the test set-up



### 5.6.3 Calculation of MPE

Maximum output power:

Frequency range from 2400.0 to 2483.5 MHz: -16.9 dBm

For MPE-Calculation the following formula has been used:

**Friis transmission formula:** 
$$P_d = \frac{P_{out} * G}{4 * \Pi * r^2}$$

**FCC ID: VQ5-EBI10**

**Limit according §1.1310 table 1, Limit for Maximum Permissible Exposure**

Frequency range from 2400 to 2483.5 MHz

**Limit for general population / uncontrolled exposures: 1.0 mW/cm<sup>2</sup>**

The EUT is according to FCC Rules 47CFR 2.1093(b) no portable device. The EUT is designed to be used that radiating structures are outside of 20 cm of the body of the user.

**Test result:**

Maximum output power to the antenna:  $P_{out} = 0.204 \text{ mW} (-16.9 \text{ dBm})$

Antenna gain:  $G = 1.28 (2.14 \text{ dBi, worst case})$

Distance r:  $r = 20 \text{ cm}$

**Power density:**  $P_d = 0.0001 \text{ mW/cm}^2$

The requirements for a non harmful use are **FULFILLED**.

**Remarks:**

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**FCC ID: VQ5-EBI10**

## **6 USED TEST EQUIPMENT AND ACCESSORIES**

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

The calibration intervals and the calibration history will be given out on request.

| <b>Test ID</b> | <b>Model / Type</b>   | <b>Kind of Equipment</b>  | <b>Manufacturer</b>  | <b>Equipment No.</b>   |
|----------------|---|---|--|--|
| A 4            | ESHS 30<br>NNLK 8129<br>ESH 2 - Z 5<br>N-4000-BNC<br>N-1500-N<br>ESH 3 - Z 2  | EMI Test Receiver<br>LISN<br>LISN<br>RF Cable<br>RF Cable<br>Pulse Limiter  | Rohde & Schwarz München<br>Schwarzbeck Mess-Elektron<br>Rohde & Schwarz München<br>mikes-testingpartners gmbh<br>mikes-testingpartners gmbh<br>Rohde & Schwarz München                 | 02-02/03-05-002<br>02-02/20-05-001<br>02-02/20-05-004<br>02-02/50-05-138<br>02-02/50-05-140<br>02-02/50-05-155                                       |
| CPC 3          | FSP 30<br>WK-340/40<br>50 Ohm / 10 dB / 18 GHz<br>Sucoflex N-2000-SMA<br>6543A  | Spectrum Analyzer<br>Climatic Chamber<br>Attenuator<br>RF Cable<br>Power Supply   | Rohde & Schwarz München<br>Weiss Umwelttechnik GmbH<br>Huber + Suhner<br>novotronik Signalverarbeit<br>HP Hewelett-Packard   | 02-02/11-05-001<br>02-02/45-05-001<br>02-02/50-05-078<br>02-02/50-05-083<br>02-02/50-05-157  |
| MB             | FSP 30<br>WK-340/40<br>50 Ohm / 10 dB / 18 GHz<br>Sucoflex N-2000-SMA<br>6543A  | Spectrum Analyzer<br>Climatic Chamber<br>Attenuator<br>RF Cable<br>Power Supply   | Rohde & Schwarz München<br>Weiss Umwelttechnik GmbH<br>Huber + Suhner<br>novotronik Signalverarbeit<br>HP Hewelett-Packard   | 02-02/11-05-001<br>02-02/45-05-001<br>02-02/50-05-078<br>02-02/50-05-083<br>02-02/50-05-157  |
| SER 1          | FMZB 1516<br>ESVS 30<br>S10162-B/+11N-50-10-5/+1<br>KK-EF393-21N-16<br>NW-2000-NB   | Magnetic Field Antenna<br>EMI Test Receiver<br>RF Cable 33m<br>RF Cable 20m<br>RF Cable   | Schwarzbeck Mess-Elektron<br>Rohde & Schwarz München<br>Huber + Suhner<br>Huber + Suhner<br>Huber + Suhner   | 01-02/24-01-018<br>02-02/03-05-003<br>02-02/50-05-031<br>02-02/50-05-033<br>02-02/50-05-113  |
| SER 2          | ESVS 30<br>VULB 9168<br>S10162-B/+11N-50-10-5/+1<br>KK-EF393-21N-16<br>NW-2000-NB   | EMI Test Receiver<br>Trilog-Broadband Anten<br>RF Cable 33m<br>RF Cable 20m<br>RF Cable   | Rohde & Schwarz München<br>Schwarzbeck Mess-Elektron<br>Huber + Suhner<br>Huber + Suhner<br>Huber + Suhner   | 02-02/03-05-006<br>02-02/24-05-005<br>02-02/50-05-031<br>02-02/50-05-033<br>02-02/50-05-113  |
| SER 3          | AFS4-01000400-10-10P-4<br>AMF-4F-04001200-15-10P<br>AFS5-12001800-18-10P-6<br>BBHA 9120 E 251<br>WBH218H N<br>Sucoflex N-2000-SMA<br>Sucoflex N-2000-SMA<br>Sucoflex N-2000-SMA | RF Amplifier 1-4 GHz<br>RF Amplifier 4-12 GHz<br>RF Amplifier 12-18 GHz<br>Broad-Band Horn Anten<br>Horn Antenna 2-18 GHz<br>RF Cable<br>RF Cable<br>RF Cable | PARZICH GMBH<br>PARZICH GMBH<br>PARZICH GMBH<br>Schwarzbeck Mess-Elektron<br>Q-par Angus Ltd<br>novotronik Signalverarbeit<br>novotronik Signalverarbeit<br>novotronik Signalverarbeit | 02-02/17-05-003<br>02-02/17-05-004<br>02-02/17-06-002<br>02-02/24-05-006<br>02-02/24-05-007<br>02-02/50-05-075<br>02-02/50-05-083<br>02-02/50-05-088 |

**FCC ID: VQ5-EBI10**

| <b>Equipment No.</b> | <b>Next Calib.</b> | <b>Last Calib.</b> | <b>Next Verif.</b> | <b>Last Verif.</b> |
|----------------------|--------------------|--------------------|--------------------|--------------------|
| 02-02/03-05-002      | 04/20/2008         | 04/20/2007         |                    |                    |
| 02-02/20-05-001      | 12.08.2007         | 06.08.2007         |                    |                    |
| 02-02/20-05-004      | 03.11.2008         | 04.11.2005         | 12.08.2007         | 06.08.2007         |
| 02-02/50-05-138      |                    |                    |                    |                    |
| 02-02/50-05-140      |                    |                    |                    |                    |
| 02-02/50-05-155      | 03/25/2008         | 09/25/2007         |                    |                    |
| 02-02/11-05-001      | 12.06.2007         | 12.06.2006         |                    |                    |
| 02-02/45-05-001      | 09.01.2008         | 09.01.2005         | 12.06.2007         | 06.06.2007         |
| 02-02/50-05-078      |                    |                    |                    |                    |
| 02-02/50-05-083      |                    |                    |                    |                    |
| 02-02/50-05-157      |                    |                    |                    |                    |
| 02-02/11-05-001      | 12.06.2007         | 12.06.2006         |                    |                    |
| 02-02/45-05-001      | 09.01.2008         | 09.01.2005         | 12.06.2007         | 06.06.2007         |
| 02-02/50-05-078      |                    |                    |                    |                    |
| 02-02/50-05-083      |                    |                    |                    |                    |
| 02-02/50-05-157      |                    |                    |                    |                    |
| 01-02/24-01-018      | 12.04.2007         | 12.04.2006         |                    |                    |
| 02-02/03-05-003      | 04/26/2008         | 04/26/2007         |                    |                    |
| 02-02/50-05-031      |                    |                    |                    |                    |
| 02-02/50-05-033      |                    |                    |                    |                    |
| 02-02/50-05-113      |                    |                    |                    |                    |
| 02-02/03-05-006      | 07/24/2008         | 07/24/2007         |                    |                    |
| 02-02/24-05-005      | 04/15/2008         | 04/15/2005         | 21.10.2008         | 21.10.2007         |
| 02-02/50-05-031      |                    |                    |                    |                    |
| 02-02/50-05-033      |                    |                    |                    |                    |
| 02-02/50-05-113      |                    |                    |                    |                    |
| 02-02/17-05-003      |                    |                    |                    |                    |
| 02-02/17-05-004      |                    |                    |                    |                    |
| 02-02/17-06-002      |                    |                    |                    |                    |
| 02-02/24-05-006      | 04/15/2008         | 04/15/2005         | 10/23/2007         | 04/23/2007         |
| 02-02/24-05-007      | 10/23/2007         | 04/23/2007         |                    |                    |
| 02-02/50-05-075      |                    |                    |                    |                    |
| 02-02/50-05-083      |                    |                    |                    |                    |
| 02-02/50-05-088      |                    |                    |                    |                    |